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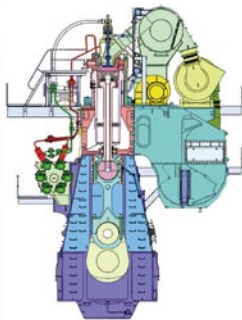


Diesel United - **WÄRTSILÄ**
Low - Speed Engines
IMO NOx Tier - II
2013

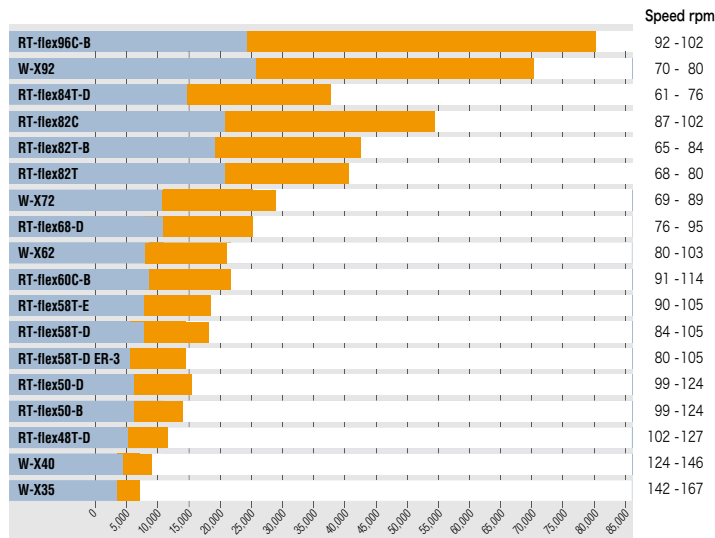
株式会社 ディーゼル ユナイテッド
DIESEL UNITED, LTD.

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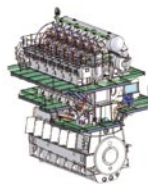


Power Range for DU-Wärtsilä Low-Speed Engines



人にやさしく、
地球にやさしく

Humane and Earth-friendly



環境規制について NOx Emission of IMO Tier-II & Tier-III

2008年10月にIMOのMEPC分科会により、Tier-II、Tier-IIIと呼ばれる将来のNOx規制であるMARPOL Annex IVが採択されました。

Tier-IIは、2011年1月1日以降建造の船について適用され、規制値はエンジン回転数によって異なりますが、Tier-Iより約20%の低減となりました。

Tier-IIIは、2016年1月1日以降建造の船について適用され、規制値はエンジン回転数によって異なりますが、Tier-Iより約80%の低減となります。但し、この規制は、船が環境規制海域に入った場合のみ適用され、その海域外ではTier-IIの規制値が適用されます。

本カタログに記載されているエンジンは、全てNOx Tier-II規制に対応しております。

In October 2008, the Marine Environment Protection Committee (MEPC) of IMO adopted amendments to the MARPOL Annex IV regulations.

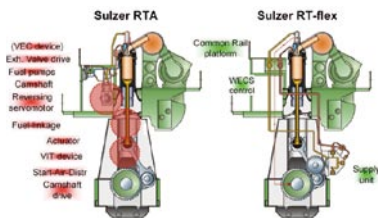
These specify further NOx emission limits to be known as IMO Tier-II and Tier-III.

Under IMO Tier-II, the NOx emission limits for engines installed in ships constructed on or after 1 January 2011 has been reduced, according to a speed-dependent function, about 20% from the presently valid IMO Tier-I levels.

Under IMO Tier-III, the NOx emission limits for engines installed in ships constructed on or after 1 January 2016 will be reduced, according to a speed-dependent function, about 80% from the presently valid IMO Tier-I levels, when the ship is operating in a designated Emission Control Area. Outside designated Emission Control Area IMO Tier-II limits apply.

All engines in this booklet can comply with the new upcoming IMO NOx Tier-II emission regulations.

電子制御の利点 Advantage of Electronically controlled engine



高い信頼性・安全性

High reliability & safety

部品の二重化、モニタリング機能

Redundant parts / Monitoring function

高い経済性

High economy

低燃費、低メンテナンスコスト

Lower fuel consumption & maintenance cost

環境にやさしい

Gentle to environment

スモークレスオペレーション

Smokeless operation

保守性の向上

Easy maintenance

カム軸、燃料ポンプ等のタイミング調整なし

No adjustment of cam shaft & fuel pump

1. 低燃料と低 NOx 排出率の両立

Consistent of lower FOC and lower NOx emission

- ・ コモンレール技術による先進の燃料噴射方式
- ・ 低負荷連続運転への適用性
- ・ Advanced fuel injection by common-rail technology
- ・ Easier to apply lower load operation

2. 10 年以上の実績と確立した信頼性

Well confirmed reliability by more than 10 years experience

- ・ 電子制御エンジンにおける世界シェアは 50%
- ・ 50% market share in electronically controlled engine market

3. シンプルな構造

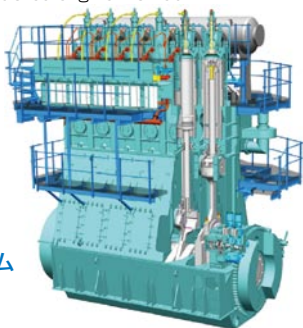
Simple and reliable structure

- ・ コモンレール技術採用
- ・ 油圧生成部と制御部分を分離
- ・ Common-rail technology applied
- ・ Simple and flexible control by separated hydraulic and control parts

4. スマートかつシンプルな制御システム

Smart and simple control concept

- ・ 分散制御コンセプト
- ・ 制御モジュールは FCM20 の 1 種類のみ
- ・ Dispersion control concept for redundancy
- ・ Only one kind of computer module as FCM20



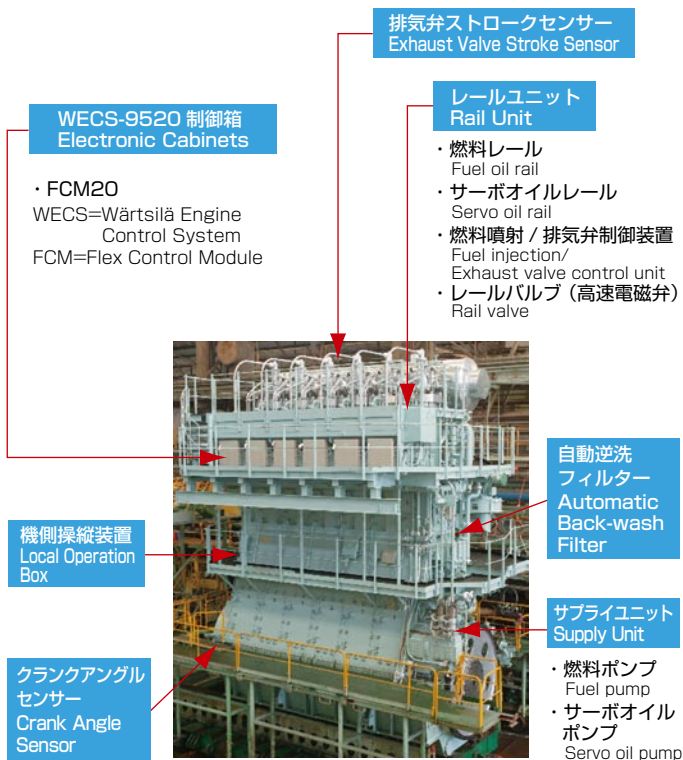
5. 自動状態診断システム LC-A との親和性

Bigger synergy effect with LC-A

- ・ 自動状態診断による予防保全
- ・ 迅速かつ的確なトラブルシューティング
- ・ 状態に基づいた最適運航設定
- ・ Preventive maintenance by the automatic condition diagnosis
- ・ Quick and exact troubleshooting
- ・ Optimum operation setting based on the actual condition



Only RT-flex engine adopt the common-rail technology for large low speed diesel engine!



レールユニット (Rail Unit)

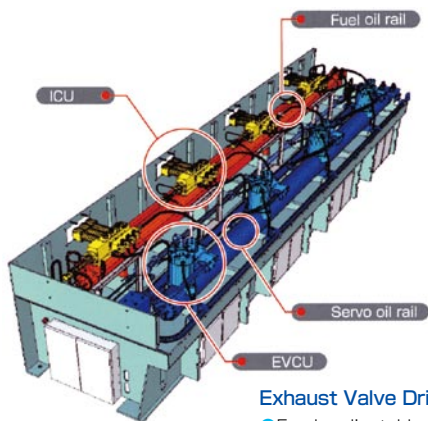
燃料噴射系

- 各シリンダの燃料弁を1本単位で制御可能です。
- 燃料噴射は WECS-9520 からの信号を ICU に設置されているレールバルブを介して制御されています。
- 低負荷域においても高圧力で燃料噴射できます。

Fuel Injection

- Independent fuel injection control for each fuel valve on each cylinder.
- WECS-9520 system controls fuel valve action by rail valve on Injection Control Unit (ICU)
- High injection pressure even at low speed

■ICU……Injection Control Unit



排気弁駆動系

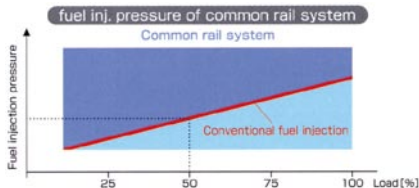
- 排気弁開閉タイミングを自由に制御できます。
- 排気弁駆動は WECS-9520 からの信号を EVCU に設置されているレールバルブを介して制御されます。
- 排気弁はストロークセンサによりフィードバック制御します。
- 排気弁作動は RTA エンジン同様に油圧で開き、エアで閉まります。

Exhaust Valve Driving

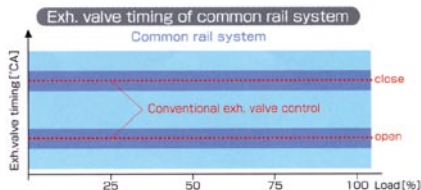
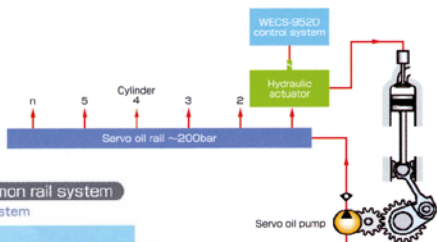
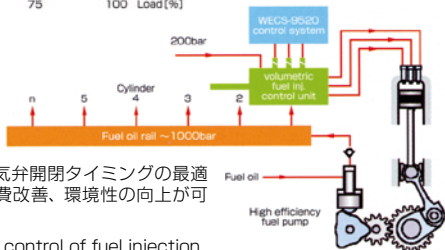
- Freely adjustable timing of valve action
- WECS-9520 system controls exhaust valve action by rail valve on Exhaust Valve Control Unit (EVCU).
- Feedback control of exhaust valve by stroke sensor.
- Reliable valve opening by hydraulic oil and valve closing by air spring, same as in proven RTA engines.

■EVCU……Exhaust Valve Control Unit

RT-flex エンジンの構造 Structure of RT-flex engine

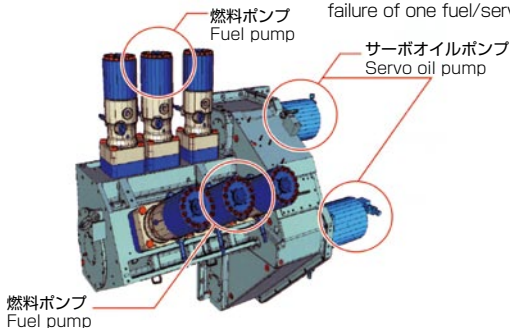


- 燃料噴射と排気弁開閉タイミングの最適制御により燃費改善、環境性の向上が可能です。
- The optimum control of fuel injection and timing of exhaust valve action for all cylinders materializes both low fuel consumption and less emission and thus contributes to environmental protection.



サブライユニット (Supply Unit)

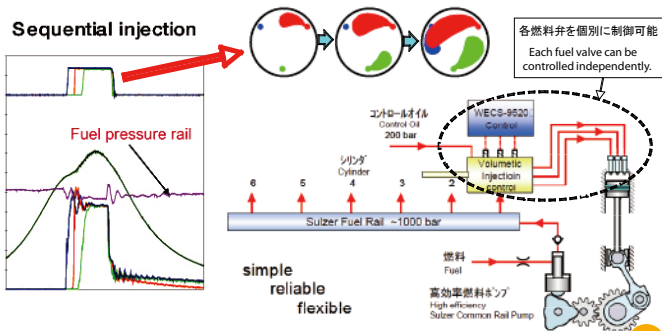
- クランク軸付歯車を介して歯車駆動します。
 - 高効率燃料ポンプを装備しています。
 - 燃料/サーボオイルは一定圧力を保つようフィードバック制御します。
 - 1ポンプが故障しても継続運転できる余裕の或る燃料/サーボオイルポンプ容量となっています。
- Driven by crankshaft gear.
 - High efficiency fuel pump.
 - Fuel oil and servo oil kept at setting pressure at each speed range.
 - Sufficient capacity of each fuel/servo pump to allow continuous operation without interruption even in case of failure of one fuel/servo pump.



シーケンシャル燃料噴射による NOx 削減 (NOx Reduction by Sequential Fuel Injection)

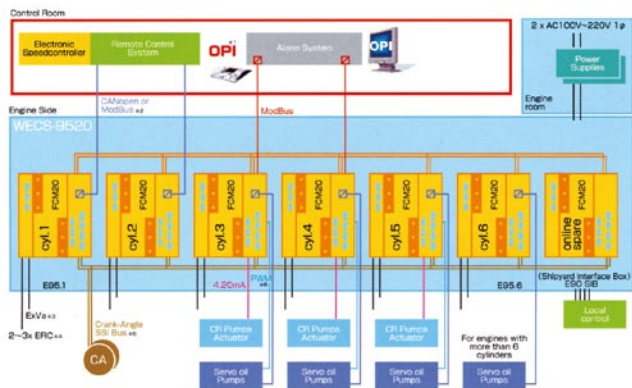
低燃費率と低NOx排出率の両立を可能とするコモンレールシステムによる技術であり、RT-flex機関のみが実現可能な燃料噴射形態です。

Common-rail technology can balance lower fuel consumption with further reduction of NOx emission, and only RT-flex engines can realize such a fuel injection system.



RT-flex エンジンの構造 Structure of RT-flex engine

WECS-9520



- WECS-9520 は各シリンダに1つとオンラインスペア1つの FCM20 制御モジュールから構成され、FCM20は取付けたシリンダ No.を確認し、各モジュールごとに与えられた役割の機器を制御します。また、万一、あるシリンダの FCM20 が故障しても、エンジンを停止させない設計としています。
- オンラインスペアは、各シリンダの FCM20 の情報を自動ダウンロードし、任意の FCM20 が故障しても、パラメータ設定やプログラムのダウンロードをすることなく、スペアとしてそのまま装備することが可能です。
- FCM20 はエンジンタイプに関わらず共用できる仕様で、予備部品の供給を容易にしています。

- WECS-9520, the core system of RT-flex engine, consists of FCM20 control modules for cylinders (one FCM module for each cylinder), one on-line spare of FCM20 and other electronic equipment in the control room. The FCM20 for each cylinder controls the equipment such as servo oil pump and CR pump actuator assigned to the cylinder. Failure in one of the FCM20s does not stop the engine.
- On-line spare FCM20 automatically downloads the data from all FCM20s for cylinder and instantly replaces a FCM20 for cylinder if it fails without resetting of parameters and downloading of program so that continuous operation of the engine may not be interrupted.
- FCM20 control module is common for all types of RT-flex engines and supply and stock of spare is easy.

■※1 OPI..... Operation Interface

■※2 CAN Controller Area Network

■※3 ExVa Exhaust Valve

■※4 EFIC Electronic Fuel Injection Control

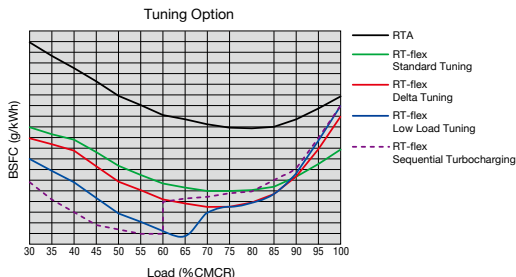
■※5 SSI..... Synchronous Serial Interface bus

■※6 PWM Pulse Width Modulation

RT-flex エンジンの性能 Performance of RT-flex engine

RT-flex 電子制御エンジンは、船舶の運航形態に合わせ、様々なチューニングを行うことができ、本船の燃料消費量削減に貢献することができます。

RT-flex electronically controlled engines can contribute fuel saving by a various tuning option to meet the actual operation of individual ship.



デルタチューニング

Delta Tuning

主に常用負荷域での燃費向上を狙うチューニングです。

ソフトウェアのパラメーターの変更のみで対応可能となります。

This is the tuning for improvement of fuel consumption at normal engine load.

It is possible only to optimize the parameter of software.

ローロードチューニング

Low Load Tuning

エンジン低負荷域での燃費性能を重視するチューニングです。

排気バイパス弁を設け、高負荷域での過給機オーバースピードを抑えます。

This is the tuning for improvement of fuel consumption at low engine load.

The exhaust waste gate can prevent the turbocharger overspeed at high engine load.

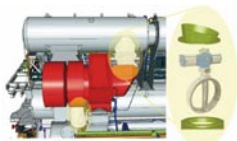
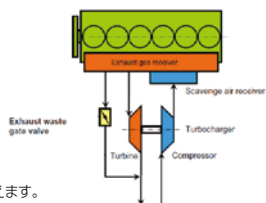
シーケンシャル過給方式

Sequential Turbocharging

過給機を複数台装備する場合、さらに低負荷域での燃費率を向上させることができます。この場合、減速運転用キットが必要になります。

Sequential turbocharging can improve the fuel consumption at low engine load in case of multipul turbocharging application.

Slow steaming upgrade kit is needed for this tuning.

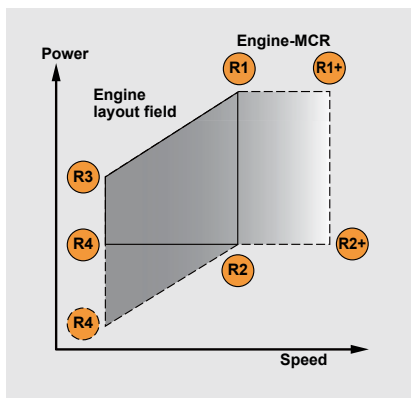


Slow steaming upgrade kit

エンジンレーティング Engine Rating

エンジンのレーティングは、出力および回転数により決められた R1, R2, R3 及び R4 ポイントの内側でエンジンの連続最大出力 (MCR) が設定されます。

The engine layout fields for DU-Wärtsilä low-speed engines are defined by the power/speed rating points R1, R2, R3 and R4.



ISO Standard Reference Condition

大気圧 (Barometric pressure)

1,000hPa

過給器ブロウ入口温度 (Suction air temperature)

25°C

相対湿度 (Relative humidity)

30%

空気冷却器冷却水温度 (Scavenge air cooling water temperature)

29°C

FUEL CONSUMPTION

All brake specific fuel consumptions (BSFC) are quoted for fuel of lower calorific value 42.7 MJ/kg, and for ISO standard reference conditions (ISO 15550 and 3046).

BSFC figures for Wärtsilä engines are given with a tolerance of +5% across 40–100% of engine load.

For engines Wärtsilä X62/72/92 & RT-flex82T-B, RT-flex58T-D ER-3, stepwise tolerances are now introduced for the brake specific fuel consumption (BSFC):

5% tolerance for 100% to 85% engine load

6% tolerance for 84% to 65% engine load

7% tolerance for 64% to 25% engine load

パルス注油システム Pulse Lubricating System

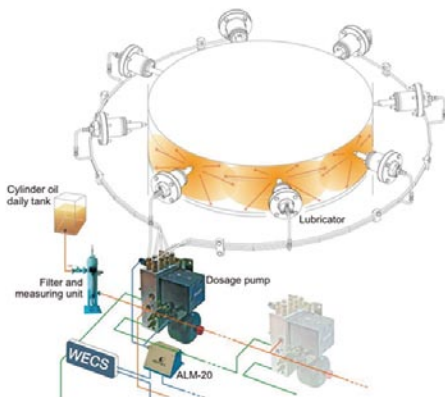
パルス注油は従来の蓄圧式注油より、さらなる注油率低減を目的として開発された注油システムです。

Pulse Lubricating System has been developed for lower lubricating oil consumption compared with the conventional accumulator system and distributes cylinder lubricating oil on the liner wall with a timed interval.

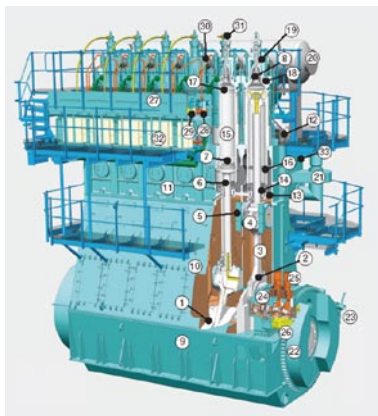
特徴

Unique Features

- シリンダ油を効率よくライナ潤滑面に給油します。
- 電子制御により任意のタイミングで注油ができます。
- 作動油はサーボオイルレールから供給できるために、特別な油圧源は不要です。
- Efficient lubricating oil distribution.
- Timing freely adjustable by electronic control.
- Hydraulic power supplied by flex servo-oil system. No supply unit or accumulator required.



WÄRTSILÄ RT-flex LOW-SPEED MARINE ENGINES



INTEGRATED ELECTRONIC CONTROL COMMON RAIL SYSTEMS FOR:

- FUEL INJECTION
- EXHAUST VALVE OPERATION
- AIR STARTING

350-960 MM CYLINDER BORE
3,475 - 80,080 KW

- | | | |
|---------------------------------|-------------------------------------|---|
| 1. Crankshaft | 14. Piston rod gland | 27. Rail unit |
| 2. Bottom end of connecting rod | 15. Cylinder liner | 28. Fuel oil rail with injection control units |
| 3. Connecting rod | 16. Scavenge air ports | 29. Servo oil rail with exhaust valve control units |
| 4. Crosshead | 17. Anti-Polishing Ring | 30. High-pressure pipes to fuel injection valves |
| 5. Crosshead guide shoes | 18. Cylinder cover | 31. Exhaust valve drive |
| 6. Piston rod | 19. Exhaust valve cage | 32. Electronic cabinets |
| 7. Piston | 20. Exhaust manifold | 33. Scavenge air receiver |
| 8. Exhaust valve | 21. Auxiliary scavenge air blower | |
| 9. Bedplate | 22. Flywheel | |
| 10. Column | 23. Turning gear | |
| 11. Cylinder block | 24. RT-flex supply unit | |
| 12. Tie rods | 25. High-pressure fuel supply pumps | |
| 13. Diaphragm | 26. Servo oil pumps | |



6RT-flex68-D



12RT-flex96C

RT-flex96C

Main data: Version B, also available as traditional RTA type

Cylinder bore..... 960 mm
 Piston stroke..... 2500 mm
 Speed..... 92-102 rpm
 Mean effective pressure at R1..... 18.6 bar
 Piston speed..... 8.5 m/s

Fuel specification:

Fuel oil..... 700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RM700

Rated power, principal dimensions and weights

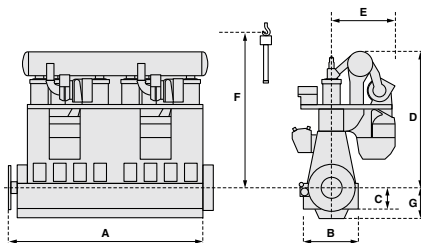
| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------|-----------------|--------|--------|--------|----------------|------------------|
| | 102 rpm | | 92 rpm | | | |
| | R1 | R2 | R3 | R4 | | |
| 6 | 34 320 | 24 000 | 30 960 | 24 000 | 12 240 | 1 160 |
| 7 | 40 040 | 28 000 | 36 120 | 28 000 | 13 920 | 1 290 |
| 8 | 45 760 | 32 000 | 41 280 | 32 000 | 16 510 | 1 470 |
| 9 | 51 480 | 36 000 | 46 440 | 36 000 | 18 190 | 1 620 |
| 10 | 57 200 | 40 000 | 51 600 | 40 000 | 19 870 | 1 760 |
| 11 | 62 920 | 44 000 | 56 760 | 44 000 | 21 550 | 1 910 |
| 12 | 68 640 | 48 000 | 61 920 | 48 000 | 23 230 | 2 050 |
| 13 | 74 360 | 52 000 | 67 080 | 52 000 | 24 910 | 2 160 |
| 14 | 80 080 | 56 000 | 72 240 | 56 000 | 26 590 | 2 300 |
| Dimensions | B | C | D | E | F* | G |
| mm | 4 480 | 1 800 | 10 925 | 5 380 | 12 950 | 2 594 |

Brake specific fuel consumption (BSFC) in g/kWh

| Full load | | | | | | |
|------------------------|---------|-----------------|----------|-------|-------|----------|
| Rating point | | | R1 | R2 | R3 | R4 |
| BMEP, bar | | | 18.6 | 13.0 | 18.6 | 14.4 |
| BSFC | RTA | | 177 | 171 | 177 | 171 |
| | RT-flex | Standard Tuning | 172 | 166 | 172 | 166 |
| Part load, % of R1 | | 85 | 70 | 85 | 70 | 65 |
| RT-flex tuning variant | | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | | 168.4 | 168.0 | 167.7 | 166.5 | 163.7 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* 13 and 14-cylinder engines are only available in RT-flex versions, and not in RTA versions.



WÄRTSILÄ X92

Main data:

Cylinder bore 920 mm
 Piston stroke 3468 mm
 Speed 70-80 rpm
 Mean effective pressure at R1 20.0/19.0 bar
 Piston speed 8.8/9.3 m/s

Fuel specification:

Fuel oil 700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMk700

RT-flex96C, W X92

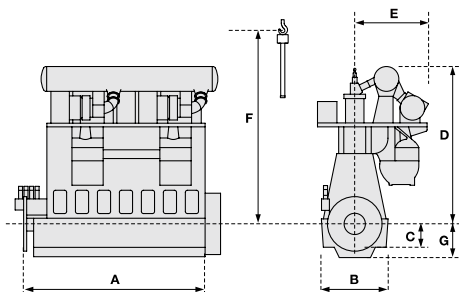
Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------|-----------------|----------|--------|--------|----------------|------------------|
| | 76/80 rpm | | 70 rpm | | | |
| | R1 / R1+ | R2 / R2+ | R3 | R4 | | |
| 6 | 35 100 | 28 080 | 32 340 | 25 860 | 11 630 | 1 120 |
| 7 | 40 950 | 32 760 | 37 730 | 30 170 | 13 210 | 1 260 |
| 8 | 46 800 | 37 440 | 43 120 | 34 480 | 16 350 | 1 460 |
| 9 | 52 650 | 42 120 | 48 510 | 38 790 | 17 850 | 1 630 |
| 10 | 58 500 | 46 800 | 53 900 | 43 100 | 19 520 | 1 790 |
| 11 | 64 350 | 51 480 | 59 290 | 47 410 | 21 280 | 1 960 |
| 12 | 70 200 | 56 160 | 64 680 | 51 720 | 22 870 | 2 140 |
| Dimensions | B | C | D | E | F* | G |
| mm | 5 550 | 1 900 | 12 750 | 6 050 | 16 100 | 2 930 |

Brake specific fuel consumption (BSFC) in g/kWh

| Full load | | | | | |
|------------------------|-----------------|-------------|-------------|-------------|-------------|
| Rating point | | R1/R1+ | R2/R2+ | R3 | R4 |
| BMEP, bar | | 20.0/19.0 | 16.0/15.2 | 20.0 | 16.0 |
| BSFC | Standard Tuning | 167.0/166.0 | 161.0 | 167.0 | 161.0 |
| Part load, % of R1/R1+ | 85 | 70 | 85 | 70 | 65 |
| Tuning variant | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | 163.4/162.4 | 163.0/162.0 | 162.7/161.7 | 161.5/160.5 | 158.2/157.4 |

* Standard piston dismantling height, can be reduced with tilted piston withdrawal.



RT-flex84T

Main data: Version D, also available as traditional RTA type

Cylinder bore 840 mm
 Piston stroke 3150 mm
 Speed 61-76 rpm
 Mean effective pressure at R1 19.0 bar
 Piston speed 8.0 m/s

Fuel specification:

Fuel oil 700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMk700

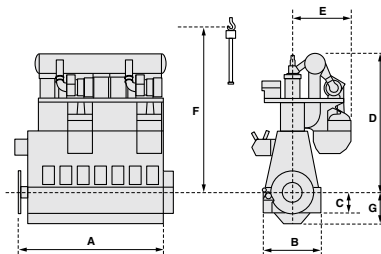
Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|--------|--------|--------|----------------|------------------|
| | 76 rpm | | 61 rpm | | | |
| | R1 | R2 | R3 | R4 | | |
| 5 | 21 000 | 14 700 | 16 850 | 14 700 | 9 695 | 740 |
| 6 | 25 200 | 17 640 | 20 220 | 17 640 | 11 195 | 870 |
| 7 | 29 400 | 20 580 | 23 590 | 20 580 | 12 695 | 990 |
| 8 | 33 600 | 23 520 | 26 960 | 23 520 | 15 195 | 1 140 |
| 9 | 37 800 | 26 460 | 30 330 | 26 460 | 16 695 | 1 260 |
| Dimensions mm | B | C | D | E | F* | G |
| | 5 000 | 1 800 | 12 150 | 5 105 | 14 500 | 2 700 |

Brake specific fuel consumption (BSFC) in g/kWh

| Full load | | | | | | |
|------------------------|---------|-----------------|----------|-------|-------|----------|
| Rating point | | | R1 | R2 | R3 | R4 |
| BMEP, bar | | | 19.0 | 13.3 | 19.0 | 16.6 |
| BSFC | RTA | | 173 | 167 | 173 | 169 |
| | RT-flex | Standard Tuning | 171 | 165 | 171 | 167 |
| Part load, % of R1 | | 85 | 70 | 85 | 70 | 65 |
| RT-flex tuning variant | | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | | 167.4 | 167.0 | 166.7 | 165.5 | 162.7 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



RT-flex82C

Main data: also available as traditional RTA type

Cylinder bore820 mm
 Piston stroke2646 mm
 Speed 87-102 rpm
 Mean effective pressure
 at R1/R1+ 20.0/19.0 bar
 Piston speed at R1/R1+ 8.6/9.0 m/s

Fuel specification:
 Fuel oil700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMK700

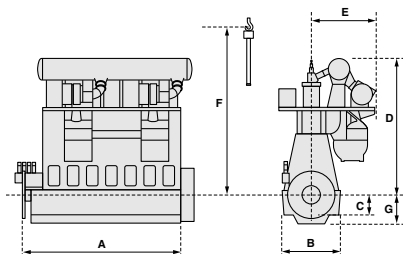
Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|--------|--------|--------|----------------|------------------|
| | 97/102 rpm | | 87 rpm | | | |
| | R1/R1+ | R2/R2+ | R3 | R4 | | |
| 6 | 27 120 | 21 720 | 24 300 | 21 720 | 11 045 | 745 |
| 7 | 31 640 | 25 340 | 28 350 | 25 340 | 12 550 | 840 |
| 8 | 36 160 | 28 960 | 32 400 | 28 960 | 14 055 | 935 |
| 9 | 40 680 | 32 580 | 36 450 | 32 580 | 16 500 | 1 005 |
| 10 | 45 200 | 36 200 | 40 500 | 36 200 | 18 005 | 1 145 |
| 11 | 49 720 | 39 820 | 44 550 | 39 820 | 19 510 | 1 230 |
| 12 | 54 240 | 43 440 | 48 600 | 43 440 | 21 015 | 1 335 |
| Dimensions mm | B | C | D | E | F* | G |
| | 4 570 | 1 600 | 10 930 | 5 400 | 12 700 | 2 310 |

Brake specific fuel consumption (BSFC) in g/kWh

| Full load | | | | | | |
|------------------------|---------|-----------------|-------------|-------------|-------------|-------------|
| Rating point | | | R1/R1+ | R2/R2+ | R3 | R4 |
| BMEP, bar | | | 20.0/19.0 | 16.0/15.2 | 20.0 | 17.9 |
| BSFC | RTA | | 177/175 | 171 | 177 | 174 |
| | RT-flex | Standard Tuning | 173/171 | 167 | 173 | 170 |
| | | | | | | |
| Part load, % of R1/R1+ | | 85 | 70 | 85 | 70 | 65 |
| RT-flex tuning variant | | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | | 169.4/167.4 | 169.0/167.0 | 168.7/166.7 | 167.5/165.5 | 164.7/162.7 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



RT-flex82T

Main data: Version B, also available as traditional RTA type

Cylinder bore.....820 mm
 Piston stroke.....3375 mm
 Speed.....65-84 rpm
 Mean effective pressure
 at R1/R1+ 21.0/19.0 bar
 Piston speed at R1/R1+ 8.6/9.5 m/s

Fuel specification:
 Fuel oil.....700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMk700

Rated power, principal dimensions and weights

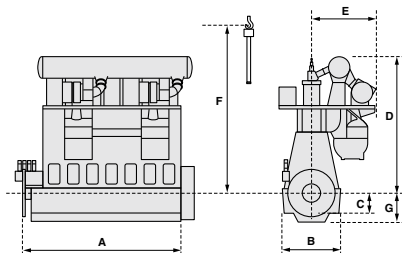
| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|--------|--------|--------|----------------|------------------|
| | 76/84 rpm | | 65 rpm | | | |
| | R1/R1+ | R2/R2+ | R3 | R4 | | |
| 6 | 28 500 | 21 720 | 24 390 | 18 600 | 11 045 | 812 |
| 7 | 33 250 | 25 340 | 28 455 | 21 700 | 12 550 | 917 |
| 8 | 38 000 | 28 960 | 32 520 | 24 800 | 14 055 | 1 028 |
| 9 | 42 750 | 32 580 | 36 585 | 27 900 | 16 500 | 1 167 |
| Dimensions mm | B | C | D | E | F* | G |
| | 5 320 | 1 800 | 12 250 | 5 400 | 14 820 | 2 700 |

Brake specific fuel consumption (BSFC) in g/kWh

| Full load | | | | | | |
|------------------------|-------------|-----------------|-------------|-------------|-------------|------|
| Rating point | | | R1/R1+ | R2/R2+ | R3 | R4 |
| BMEP, bar | | | 21.0/19.0 | 16.0/14.5 | 21.0 | 16.0 |
| BSFC | RTA | | 171/169 | 164 | 171 | 164 |
| | RT-flex | Standard Tuning | 166/164 | 159 | 166 | 159 |
| Part load, % of R1/R1+ | 85 | 70 | 85 | 70 | 65 | |
| RT-flex tuning variant | Standard | Standard | Delta | Delta | Low-Load | |
| BSFC | 162.4/160.4 | 162.0/160.0 | 161.7/159.7 | 160.5/158.5 | 157.2/155.5 | |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* FAST Nozzle applied.



RT-flex82T

Main data: also available as traditional RTA type

Cylinder bore820 mm
 Piston stroke.....3375 mm
 Speed 68-80 rpm
 Mean effective pressure
 at R1/R1+ 20.0/19.0 bar
 Piston speed at R1/R1+8.6/9.0 m/s

Fuel specification:
 Fuel oil.....700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMK700

Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|--------|--------|--------|----------------|------------------|
| | 76/80 rpm | | 68 rpm | | | |
| | R1/R1+ | R2/R2+ | R3 | R4 | | |
| 6 | 27 120 | 21 720 | 24 300 | 21 720 | 11 045 | 812 |
| 7 | 31 640 | 25 340 | 28 350 | 25 340 | 12 550 | 917 |
| 8 | 36 160 | 28 960 | 32 400 | 28 960 | 14 055 | 1 028 |
| 9 | 40 680 | 32 580 | 36 450 | 32 580 | 16 500 | 1 167 |
| Dimensions mm | B | C | D | E | F* | G |
| | 5 320 | 1 800 | 12 250 | 5 400 | 14 820 | 2 700 |

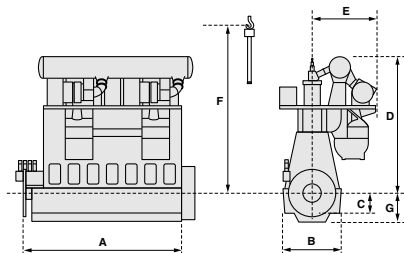
Brake specific fuel consumption (BSFC) in g/kWh

Full load

| Rating point | | R1/R1+ | R2/R2+ | R3 | R4 |
|--------------|----------------------------|-----------|-----------|------|------|
| BMEP, bar | | 20.0/19.0 | 16.0/14.5 | 20.0 | 16.0 |
| BSFC | RTA | 171/169 | 164 | 171 | 164 |
| | RT-flex Standard Tuning | 168/166 | 162 | 168 | 165 |

| Part load, % of R1/R1+ | 85 | 70 | 85 | 70 | 65 |
|------------------------|-------------|-------------|-------------|-------------|-------------|
| RT-flex tuning variant | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | 164.4/162.4 | 164.0/162.0 | 163.7/161.7 | 162.5/160.5 | 159.7/157.7 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ X72

Main data:

Cylinder bore.....720 mm
 Piston stroke.....3086 mm
 Speed.....69-89 rpm
 Mean effective pressure
 at R1/R1+ 20.5/19.4 bar
 Piston speed at R1/R1+ 8.6/9.2 m/s

Fuel specification:
 Fuel oil.....700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMK700

Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|--------|--------|--------|----------------|------------------|
| | 84/89 rpm | | 69 rpm | | | |
| | R1/R1+ | R2/R2+ | R3 | R4 | | |
| 4 | 14 440 | 10 800 | 11 880 | 8 880 | 6 770 | 407 |
| 5 | 18 050 | 13 500 | 14 850 | 11 100 | 8 060 | 481 |
| 6 | 21 660 | 16 200 | 17 820 | 13 320 | 9 350 | 561 |
| 7 | 25 270 | 18 900 | 20 790 | 15 540 | 10 645 | 642 |
| 8 | 28 880 | 21 600 | 23 760 | 17 760 | 11 935 | 716 |
| Dimensions mm | B | C | D | E | F* | G |
| | 4 850 | 1 580 | 11 640 | 4 380 | 13 950 | 2 380 |

Brake specific fuel consumption (BSFC) in g/kWh

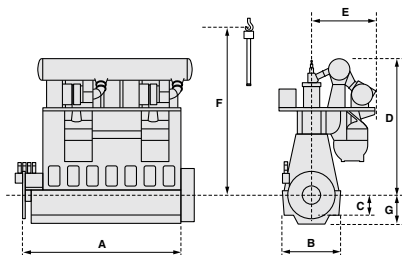
Full load

| | | | | | |
|--------------|---------|-----------------|-----------|------|------|
| Rating point | | R1/R1+ | R2/R2+ | R3 | R4 |
| BMEP, bar | | 20.5/19.4 | 15.4/14.5 | 20.5 | 15.4 |
| BSFC | RT-flex | Standard Tuning | 168/167 | 161 | 168 |
| | | | | 168 | 161 |

Part load, % of R1/R1+

| | | | | | |
|----------------|-------------|-------------|-------------|-------------|-------------|
| | 85 | 70 | 85 | 70 | 65 |
| Tuning variant | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | 164.4/163.4 | 164.0/163.0 | 163.7/162.7 | 162.5/161.5 | 159.2/158.4 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



RT-flex68

Main data: Version D, also available as traditional RTA type

Cylinder bore 680 mm
 Piston stroke 2720 mm
 Speed 76-95 rpm
 Mean effective pressure at R1 20.0 bar
 Piston speed 8.6 m/s

Fuel specification:
 Fuel oil 700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMK700

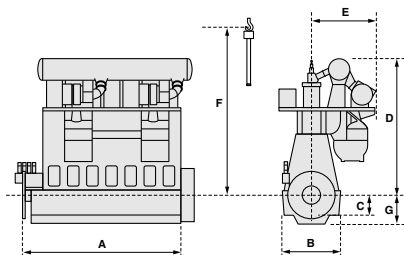
Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|--------|--------|--------|----------------|------------------|
| | 95 rpm | | 76 rpm | | | |
| | R1 | R2 | R3 | R4 | | |
| 5 | 15 650 | 10 950 | 12 500 | 10 950 | 7 530 | 386 |
| 6 | 18 780 | 13 140 | 15 000 | 13 140 | 8 710 | 439 |
| 7 | 21 910 | 15 330 | 17 500 | 15 330 | 9 890 | 496 |
| 8 | 25 040 | 17 520 | 20 000 | 17 520 | 11 070 | 552 |
| Dimensions mm | B | C | D | E | F* | G |
| | 4 300 | 1 520 | 10 400 | 4 700 | 12 545 | 2 340 |

Brake specific fuel consumption (BSFC) in g/kWh

| Full load | | | | | | |
|------------------------|---------|-----------------|----------|-------|-------|----------|
| Rating point | | | R1 | R2 | R3 | R4 |
| BMEP, bar | | | 20.0 | 14.0 | 20.0 | 17.5 |
| BSFC | RTA | | 174 | 168 | 174 | 170 |
| | RT-flex | Standard Tuning | 170 | 164 | 170 | 166 |
| Part load, % of R1 | | 85 | 70 | 85 | 70 | 60 |
| RT-flex tuning variant | | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | | 166.4 | 166.0 | 165.7 | 164.5 | 162.2 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ X62

Main data:

Cylinder bore.....620 mm
 Piston stroke.....2658 mm
 Speed.....80-103 rpm
 Mean effective pressure
 at R1/R1+ 20.5/19.3 bar
 Piston speed at R1/R1+ 8.6/9.1 m/s

Fuel specification:
 Fuel oil.....700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RM700

Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|--------|--------|--------|----------------|------------------|
| | 97/103 rpm | | 80 rpm | | | |
| | R1/R1+ | R2/R2+ | R3 | R4 | | |
| 4 | 10 640 | 8 000 | 8 760 | 6 600 | 5 895 | 270 |
| 5 | 13 300 | 10 000 | 10 950 | 8 250 | 7 030 | 325 |
| 6 | 15 960 | 12 000 | 13 140 | 9 900 | 8 110 | 377 |
| 7 | 18 620 | 14 000 | 15 330 | 11 550 | 9 215 | 435 |
| 8 | 21 280 | 16 000 | 17 520 | 13 200 | 10 320 | 482 |
| Dimensions mm | B | C | D | E | F* | G |
| | 4 180 | 1 360 | 10 050 | 3 915 | 11 950 | 2 070 |

Brake specific fuel consumption (BSFC) in g/kWh

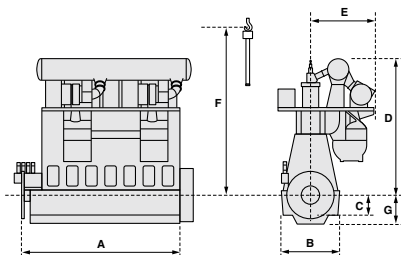
Full load

| Rating point | | R1/R1+ | R2/R2+ | R3 | R4 |
|--------------|---------|-----------------|-----------|------|------|
| BMEP, bar | | 20.5/19.3 | 15.4/14.5 | 20.5 | 15.4 |
| BSFC | RT-flex | Standard Tuning | 167/166 | 160 | 167 |

Part load, % of R1/R1+

| | 85 | 70 | 85 | 70 | 65 |
|----------------|-------------|-------------|-------------|-------------|-------------|
| Tuning variant | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | 163.4/162.4 | 163.0/162.0 | 162.7/161.7 | 161.5/160.5 | 158.2/157.4 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



RT-flex60C

Main data: Version B

Cylinder bore 600 mm
 Piston stroke 2250 mm
 Speed 91-114 rpm
 Mean effective pressure at R1 20.0 bar
 Piston speed 8.6 m/s

Fuel specification:
 Fuel oil 700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMK700

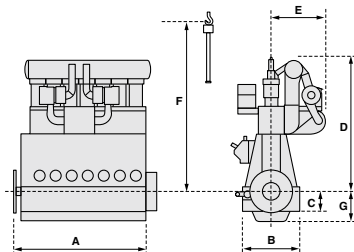
Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|--------|--------|--------|----------------|------------------|
| | 114 rpm | | 91 rpm | | | |
| | R1 | R2 | R3 | R4 | | |
| 5 | 12 100 | 8 450 | 9 650 | 8 450 | 6 638 | 268 |
| 6 | 14 520 | 10 140 | 11 580 | 10 140 | 7 678 | 322 |
| 7 | 16 940 | 11 830 | 13 510 | 11 830 | 8 718 | 377 |
| 8 | 19 360 | 13 520 | 15 440 | 13 520 | 9 758 | 428 |
| 9 | 21 780 | 15 210 | 17 370 | 15 210 | 10 798 | 480 |
| Dimensions mm | B | C | D | E | F* | G |
| | 3 700 | 1 300 | 8 570 | 3 660 | 10 500 | 1 955 |

Brake specific fuel consumption (BSFC) in g/kWh

| | | | | | | |
|---------------------------|---------|-----------------|----------|-------|-------|----------|
| Full load | | | | | | |
| Rating point | | | R1 | R2 | R3 | R4 |
| BMEP, bar | | | 20.0 | 14.0 | 20.0 | 17.5 |
| BSFC | RT-flex | Standard Tuning | 171 | 165 | 171 | 167 |
| Part load, % of R1 | | | | | | |
| | | 85 | 70 | 85 | 70 | 60 |
| RT-flex tuning variant | | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | | 167.4 | 167.0 | 166.7 | 165.5 | 163.2 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



RT-flex58T

Main data: Version E

Cylinder bore..... 580 mm
 Piston stroke..... 2416 mm
 Speed..... 90-105 rpm
 Mean effective pressure at R1..... 21.0 bar
 Piston speed..... 8.5 m/s

Fuel specification:

Fuel oil..... 700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMK700

Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|--------|--------|--------|----------------|------------------|
| | 105 rpm | | 90 rpm | | | |
| | R1 | R2 | R3 | R4 | | |
| 5 | 11 750 | 7 900 | 10 075 | 7 900 | 6 381 | 281 |
| 6 | 14 100 | 9 480 | 12 090 | 9 480 | 7 387 | 322 |
| 7 | 16 450 | 11 060 | 14 105 | 11 060 | 8 393 | 377 |
| 8 | 18 800 | 12 640 | 16 120 | 12 640 | 9 399 | 418 |
| Dimensions mm | B | C | D | E | F* | G |
| | 3 820 | 1 300 | 8 822 | 3 475 | 10 880 | 2 000 |

Brake specific fuel consumption (BSFC) in g/kWh

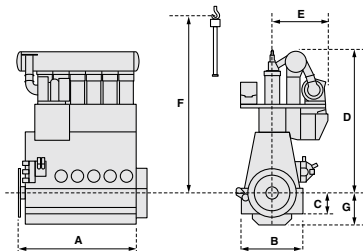
Full load

| | | | | | | |
|--------------|---------|-----------------|------|------|------|------|
| Rating point | | | R1 | R2 | R3 | R4 |
| BMEP, bar | | | 21.0 | 14.1 | 21.0 | 16.5 |
| BSFC | RT-flex | Standard Tuning | 168 | 162 | 168 | 162 |

| | | | | | |
|------------------------|----------|----------|-------|-------|----------|
| Part load, % of R1 | 85 | 70 | 85 | 70 | 60 |
| RT-flex tuning variant | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | 164.4 | 164.0 | 163.7 | 162.5 | 160.2 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* FAST Nozzle applied.



RT-flex58T

Main data: Version D, also available as traditional RTA type

Cylinder bore..... 580 mm
 Piston stroke..... 2416 mm
 Speed..... 84-105 rpm
 Mean effective pressure at R1..... 20.2 bar
 Piston speed..... 8.5 m/s

Fuel specification:

Fuel oil.....700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMk700

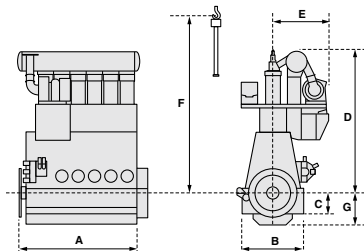
Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|--------|--------|--------|----------------|------------------|
| | 105 rpm | | 84 rpm | | | |
| | R1 | R2 | R3 | R4 | | |
| 5 | 11 300 | 7 900 | 9 050 | 7 900 | 6 381 | 281 |
| 6 | 13 560 | 9 480 | 10 860 | 9 480 | 7 387 | 322 |
| 7 | 15 820 | 11 060 | 12 670 | 11 060 | 8 393 | 377 |
| 8 | 18 080 | 12 640 | 14 480 | 12 640 | 9 399 | 418 |
| Dimensions mm | B | C | D | E | F* | G |
| | 3 820 | 1 300 | 8 822 | 3 475 | 10 880 | 2 000 |

Brake specific fuel consumption (BSFC) in g/kWh

| Full load | | | | | | |
|------------------------|---------|-----------------|----------|-------|-------|----------|
| Rating point | | | R1 | R2 | R3 | R4 |
| BMEP, bar | | | 20.2 | 14.1 | 20.2 | 17.7 |
| BSFC | RTA | | 174 | 168 | 174 | 170 |
| | RT-flex | Standard Tuning | 169 | 163 | 169 | 165 |
| Part load, % of R1 | | 85 | 70 | 85 | 70 | 60 |
| RT-flex tuning variant | | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | | 165.4 | 165.0 | 164.7 | 163.5 | 161.2 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



RT-flex58T-D ER-3

Main data:

Cylinder bore..... 550 mm
 Piston stroke..... 2416 mm
 Speed..... 80-105 rpm
 Mean effective pressure at R1..... 20.2 bar
 Piston speed..... 8.5 m/s

Fuel specification:

Fuel oil..... 700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMK700

Rated power, principal dimensions and weights

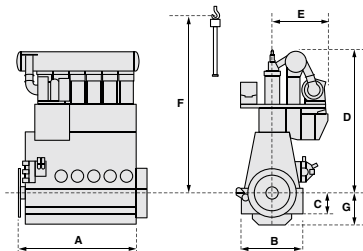
| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|-------|--------|-------|----------------|------------------|
| | 105 rpm | | 80 rpm | | | |
| | R1 | R2 | R3 | R4 | | |
| 5 | 10 175 | 7 100 | 7 750 | 5 400 | 6 381 | 281 |
| 6 | 12 210 | 8 520 | 9 300 | 6 480 | 7 387 | 322 |
| 7 | 14 245 | 9 940 | 10 850 | 7 560 | 8 393 | 377 |
| Dimensions mm | B | C | D | E | F* | G |
| | 3 820 | 1 300 | 8 822 | 3 475 | 10 880 | 2 000 |

Brake specific fuel consumption (BSFC) in g/kWh

| Full load | | | | | | |
|------------------------|---------|-----------------|----------|-------|-------|----------|
| Rating point | | | R1 | R2 | R3 | R4 |
| BMEP, bar | | | 20.2 | 14.1 | 20.2 | 14.1 |
| BSFC | RT-flex | Standard Tuning | 167 | 161 | 167 | 161 |
| Part load, % of R1 | | 85 | 70 | 85 | 70 | 60 |
| RT-flex tuning variant | | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | | 163.4 | 163.0 | 162.7 | 161.5 | 159.2 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

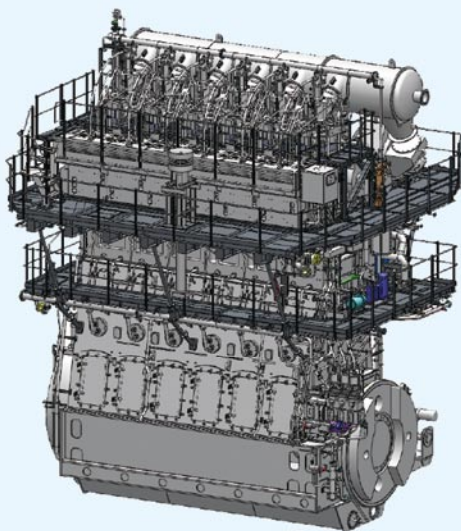
* FAST Nozzle applied.



6RT-flex58T-D ER3

Power ; 9680kW

R P M ; 90rpm



RT-flex50

Main data: Version D

Cylinder bore 500 mm
 Piston stroke 2050 mm
 Speed 99-124 rpm
 Mean effective pressure at R1 21.0 bar
 Piston speed 8.5 m/s

Fuel specification:

Fuel oil 700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMk700

Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|--------|--------|--------|----------------|------------------|
| | 124 rpm | | 99 rpm | | | |
| | R1 | R2 | R3 | R4 | | |
| 5 | 8 725 | 6 100 | 6 975 | 6 100 | 5 582 | 200 |
| 6 | 10 470 | 7 320 | 8 370 | 7 320 | 6 462 | 225 |
| 7 | 12 215 | 8 540 | 9 765 | 8 540 | 7 342 | 255 |
| 8 | 13 960 | 9 760 | 11 160 | 9 760 | 8 222 | 280 |
| 9 | 15 705 | 10 980 | 12 555 | 10 980 | 9 102 | 315 |
| Dimensions mm | B | C | D | E | F* | G |
| | 3 150 | 1 088 | 7 646 | 3 710 | 9 270 | 1 636 |

Brake specific fuel consumption (BSFC) in g/kWh

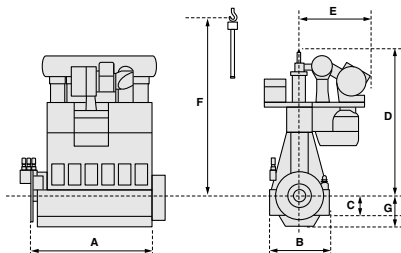
Full load

| Rating point | | | R1 | R2 | R3 | R4 |
|--------------|---------|-----------------|------|------|------|------|
| BMEP, bar | | | 21.0 | 14.7 | 21.0 | 18.4 |
| SBFC | RT-flex | Standard Tuning | 170 | 164 | 170 | 166 |

| Part load, % of R1 | 85 | 70 | 85 | 70 | 60 |
|------------------------|----------|----------|-------|-------|----------|
| RT-flex tuning variant | Standard | Standard | Delta | Delta | Low-Load |
| SBFC | 166.4 | 166.0 | 165.7 | 164.5 | 162.2 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Aft-end turbocharger arrangement available.



RT-flex50

Main data: Version B

Cylinder bore..... 500 mm
 Piston stroke..... 2050 mm
 Speed..... 99-124 rpm
 Mean effective pressure at R1..... 20.0 bar
 Piston speed..... 8.5 m/s

Fuel specification:

Fuel oil..... 700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMk700

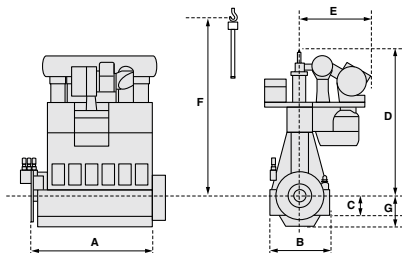
Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|-------|--------|-------|----------------|------------------|
| | 124 rpm | | 99 rpm | | | |
| | R1 | R2 | R3 | R4 | | |
| 5 | 8 300 | 5 800 | 6 650 | 5 800 | 5 582 | 200 |
| 6 | 9 960 | 6 960 | 7 980 | 6 960 | 6 462 | 225 |
| 7 | 11 620 | 8 120 | 9 310 | 8 120 | 7 342 | 255 |
| 8 | 13 280 | 9 280 | 10 640 | 9 280 | 8 222 | 280 |
| Dimensions mm | B | C | D | E | F* | G |
| | 3 150 | 1 088 | 7 646 | 3 690 | 9 270 | 1 636 |

Brake specific fuel consumption (BSFC) in g/kWh

| | | | | | | |
|---------------------------|---------|-----------------|----------|-------|-------|----------|
| Full load | | | | | | |
| Rating point | | | R1 | R2 | R3 | R4 |
| BMEP, bar | | | 20.0 | 13.9 | 20.0 | 17.5 |
| BSFC | RT-flex | Standard Tuning | 171 | 165 | 171 | 167 |
| Part load, % of R1 | | | | | | |
| RT-flex tuning variant | | 85 | 70 | 85 | 70 | 60 |
| BSFC | | Standard | Standard | Delta | Delta | Low-Load |
| | | 167.4 | 167.0 | 166.7 | 165.5 | 163.2 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



RT-flex48T

Main data: Version D, also available as traditional RTA type

Cylinder bore..... 480 mm
 Piston stroke..... 2000 mm
 Speed..... 102-127 rpm
 Mean effective pressure at R1..... 19.0 bar
 Piston speed..... 8.5 m/s

Fuel specification:
 Fuel oil..... 700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMk700

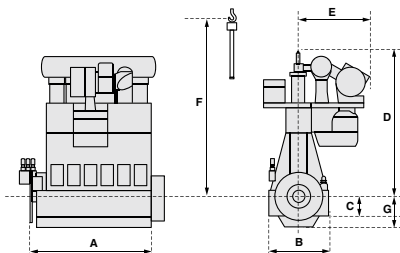
Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|-------|---------|-------|----------------|------------------|
| | 127 rpm | | 102 rpm | | | |
| | R1 | R2 | R3 | R4 | | |
| 5 | 7 275 | 5 100 | 5 825 | 5 100 | 5 314 | 171 |
| 6 | 8 730 | 6 120 | 6 990 | 6 120 | 6 148 | 205 |
| 7 | 10 185 | 7 140 | 8 155 | 7 140 | 6 982 | 225 |
| 8 | 11 640 | 8 160 | 9 320 | 8 160 | 7 816 | 250 |
| Dimensions mm | B | C | D | E | F* | G |
| | 3 170 | 1 085 | 7 334 | 3 253 | 9 030 | 1 700 |

Brake specific fuel consumption (BSFC) in g/kWh

| | | | | | | |
|---------------------------|---------|-----------------|----------|-------|-------|----------|
| Full load | | | | | | |
| Rating point | | | R1 | R2 | R3 | R4 |
| BMEP, bar | | | 19.0 | 13.3 | 19.0 | 16.6 |
| BSFC | RTA | | 173 | 167 | 173 | 169 |
| | RT-flex | Standard Tuning | 170 | 164 | 170 | 166 |
| Part load, % of R1 | | 85 | 70 | 85 | 70 | 60 |
| RT-flex tuning variant | | Standard | Standard | Delta | Delta | Low-Load |
| BSFC | | 166.4 | 166.0 | 165.7 | 164.5 | 162.2 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.




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AFTER SALES
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LC-A
Life Cycle Administrator
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新着情報
[一覧を見る](#)

2012.08.19 **技術** [1000馬力4400mm 直列6気筒ディーゼルエンジン完成](#)

2012.08.11 **トピックス** [RT-flex 電圧制御エンジン 1000馬力完成](#)

2012.09.20 **技術** [RT-flex 300 D 100 2 の最新のカンパニオンエンジンの発表を
見逃しません。](#)

2012.09.11 **トピックス** [MF-Detector を 1 月 1 日 以降で紹介しています。](#)

2012.08.10 **インフォメーション** [アスベストフリー宣言書について](#)

2012.08.09 **インフォメーション** [JICA のアスベスト宣言書について](#)

2012.08.01 **技術** [MF-Detector のバージョンを刷新しました。](#)

2012.07.20 **技術** [RT-flex 300 D 100 2 の最新のカンパニオンエンジンの発表を
見逃しません。](#)

採用情報


高機能機器


- TF-Detector
- Piston Viewer
- MF-Detector
- LC-A
- AWP-Kit

お役立ち情報


出張見聞録


<http://www.ihico.jp/du/>

当社ウェブサイトにて、最新情報や技術資料をいつでもご覧いただけます。
The updated information and latest technical materials on our website can be viewed at anytime.

WÄRTSILÄ X40

Main data:

Cylinder bore..... 400 mm
 Piston stroke..... 1770 mm
 Speed..... 124-146 rpm
 Mean effective pressure at R1..... 21.0 bar
 Piston speed..... 8.6 m/s

Fuel specification:

Fuel oil..... 700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMK700

Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|-------|---------|-------|----------------|------------------|
| | 146 rpm | | 124 rpm | | | |
| | R1 | R2 | R3 | R4 | | |
| 5 | 5 675 | 4 550 | 4 825 | 4 550 | 5 050 | 109 |
| 6 | 6 810 | 5 460 | 5 790 | 5 460 | 5 750 | 125 |
| 7 | 7 945 | 6 370 | 6 755 | 6 370 | 6 450 | 140 |
| 8 | 9 080 | 7 280 | 7 720 | 7 280 | 7 150 | 153 |
| Dimensions mm | B | C | D | E | F* | G |
| | 2 590 | 950 | 6 335 | 1 660 | 7 700 | 1 425 |

Brake specific fuel consumption (BSFC) in g/kWh

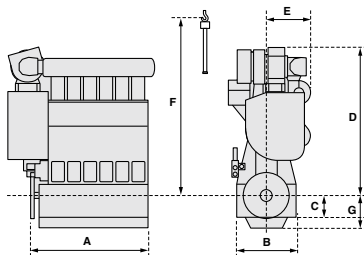
Full load

| | | | | | | |
|--------------|---------|-----------------|------|------|------|------|
| Rating point | | | R1 | R2 | R3 | R4 |
| BMEP, bar | | | 21.0 | 16.8 | 21.0 | 19.8 |
| IMO Tier II | RT-flex | Standard Tuning | 175 | 169 | 175 | 173 |

Part load, % of R1

| | | | | | |
|------------------------|----------|----------|-------|-------|----------|
| | 85 | 70 | 85 | 70 | 60 |
| RT-flex tuning variant | Standard | Standard | Delta | Delta | Low-Load |
| IMO Tier II | 171.4 | 171.0 | 170.7 | 169.5 | 167.2 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WÄRTSILÄ X35

Main data:

Cylinder bore..... 350 mm
 Piston stroke..... 1550 mm
 Speed..... 142-167 rpm
 Mean effective pressure at R1..... 21.0 bar
 Piston speed..... 8.6 m/s

Fuel specification:
 Fuel oil..... 700 cSt/50°C
 ISO-F 8217:2005,
 category ISO-RMK700

Rated power, principal dimensions and weights

| Cyl. | Output in kW at | | | | Length A mm | Weight tonnes |
|------------------|-----------------|-------|---------|-------|----------------|------------------|
| | 167 rpm | | 142 rpm | | | |
| | R1 | R2 | R3 | R4 | | |
| 5 | 4 350 | 3 475 | 3 700 | 3 475 | 4 434 | 74 |
| 6 | 5 220 | 4 170 | 4 440 | 4 170 | 5 046 | 84 |
| 7 | 6 090 | 4 865 | 5 180 | 4 865 | 5 658 | 95 |
| 8 | 6 960 | 5 560 | 5 920 | 5 560 | 6 270 | 105 |
| Dimensions mm | B | C | D | E | F* | G |
| | 2 264 | 830 | 5 556 | 1 220 | 6 850 | 1 326 |

Brake specific fuel consumption (BSFC) in g/kWh

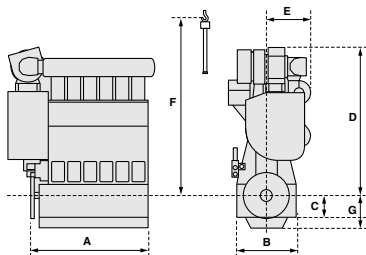
Full load

| | | | | | | |
|--------------|---------|-----------------|------|------|------|------|
| Rating point | | | R1 | R2 | R3 | R4 |
| BMEP, bar | | | 21.0 | 16.8 | 21.0 | 19.8 |
| IMO Tier II | RT-flex | Standard Tuning | 176 | 170 | 176 | 174 |

Part load, % of R1

| | | | | | |
|------------------------|----------|----------|-------|-------|----------|
| | 85 | 70 | 85 | 70 | 60 |
| RT-flex tuning variant | Standard | Standard | Delta | Delta | Low-Load |
| IMO Tier II | 172.4 | 172.0 | 171.7 | 170.5 | 168.2 |

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

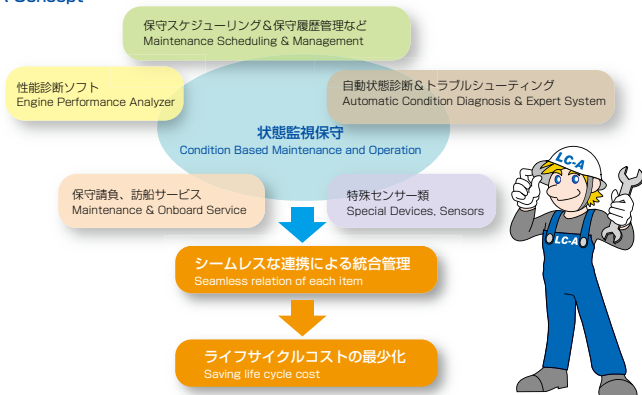


統合保守支援システム LC-A LifeCycle Administrator

RT-flex 電子制御エンジンには多くのセンサーが装備されていることから、エンジンの各種情報を細かく把握することができます。オプションの LC-A サービスパッケージを組み合わせれば、効率運航、主機関の予防保全を行うことができ、本船のライフサイクルに渡って、より安全運航に寄与し、また、コスト低減に貢献いたします。

Various information on the engine can be found in detail from a lot of sensors on RT-flex electronically controlled engines. In combination with LC-A service package, it contributes to save the lifecycle cost by preventive maintenance and optimum operation setting, and to safty operation.

LC-A のコンセプト LC-A Concept



期待される導入メリット

- 最適な設定による**オペレーションコストの削減**
- 自動診断や CBM などによる**省力化**
- 統一された情報管理による**書類業務の削減**
- 異常発生時の**復旧時間の縮小**
- 予期しない off-hire の減少**
- 良い状態を維持することで中古市場での船舶価値の向上**

Expected advantage

- Saving operating cost** by optimum setting
- Labor-saving** by automatic diagnosis, CBM etc.
- Reduction of document works** by unified information management
- Reduction of recovery time** when some abnormality happened
- Less unexpected off hire**
- Keeping good condition and increasing vessel value** in used market



自動状態診断 Automatic condition diagnosis



1. 保守管理と予防保全 Condition Based Maintenance & Preventive Maintenance

1. 自動状態診断システムは、関連する測定結果、検査結果に基づき状態指数を算出します。
 2. 状態指数がある値を超えた場合、警告を示すと同時に、トラブルシューティングのためにエキスパート・システムに情報を送ります。
 3. 状態指数は、予防保全システムと保守管理システムからも参照し、オーバーホールの時期や検査の最適化にも使用されます。
1. Automatic condition diagnosis system calculates Condition index by related measurements and inspection results according to developed logic.
 2. If Condition index is over the certain value, the system shows warning on PC screen and sends the information to Expert system for troubleshooting.
 3. Condition index is sent to Preventive maintenance system and Maintenance management system for optimization of inspection or overhaul timing.

予防保守 Preventive maintenance

- ・傾向診断
Trend diagnosis
- ・メンテナンス予測
Maintenance prediction
- ・その他
Etc.

最適なオペレーション Optimized operation

- ・最適なシリンダ注油量
Optimum cylinder oil feed rate
- ・最適な噴射時期
Optimum injection timing
- ・その他
Etc.

2. 最適オペレーションの設定 Condition Based Optimum Operation Setting

1. 自動状態診断システムは、各部の状態指数を算出します。
 2. 最適運転システムは算出された状態指数などにに基づき、注油率や燃料噴射タイミングなどの最適設定値を算出します。
1. Automatic condition diagnosis system calculates Condition index of each part.
 2. Optimized operation system calculates and shows optimum value of each settings, according to Condition indexes and developed logic.



3. トラブルシューティング Troubleshooting



エキスパートシステム Expert system

・トラブルシューティング
Troubleshooting

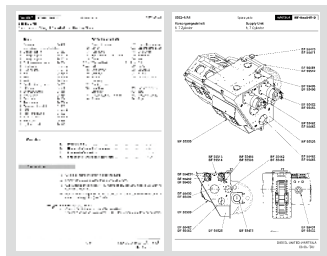
・修理方法
How to repair
・その他
Etc.



- チェックと復旧作業のための作業要領書
Special instructions for checking and recovery work



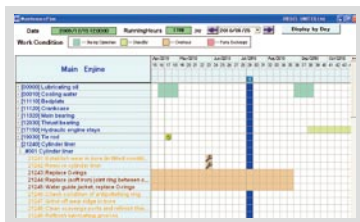
- 通常の取扱説明書
Related standard instruction, code book, etc.



多くの写真付きで、非常に
分かりやすくて要領書
Very plain instruction with
many pictures.

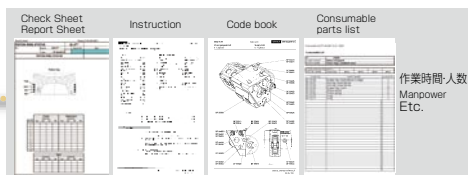
1. エクスパートシステムは異常情報を検知すると、各種測定値などの情報に基づき、自動的に推定故障部品、要因をリストアップします。
 2. 推定故障部品、要因が何処であるかをイラスト上に示すとともに、その写真を表示します。
 3. 対応するチェックと復旧作業のための作業要領書を抽出、表示します。
 4. 対応する取扱説明書、コードブックを抽出、表示します。
1. When **Expert system** receives information of abnormality, then it lists up estimated failure parts and factor automatically.
 2. **Expert system** indicates where the parts are installed on engine with picture.
 3. **Expert system** shows special instructions for checking and recovery work.
 4. **Expert system** shows relative instruction manuals and code book, too.

4. 保守管理 Maintenance Management

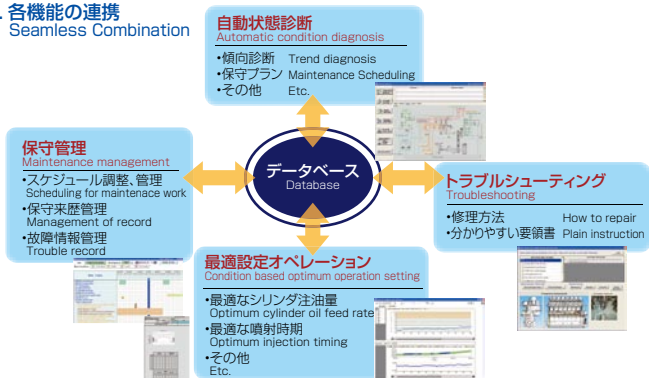


1. 保守管理システムで管理するもの
 - ・保守、検査スケジュール
 - ・保守、検査結果とレポート作成補助、履歴管理
 - ・その他
2. 保守管理システムで得られる情報
 - ・保守作業による消耗部品
 - ・関連する取扱説明書、コードブックなど
1. Managing following information.
 - ・ Maintenance and inspection schedule
 - ・ Inspection results and reports
 - ・ Etc.
2. Showing following information.
 - ・ Consumable parts by maintenance work
 - ・ Related instructions, code book, etc.

作業に必要な情報を
自動抽出
Distilling related
instructions for work



5. 各機能の連携 Seamless Combination

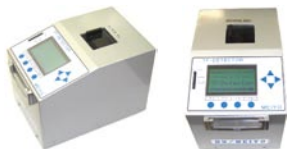


1. 各機能は単一のデータベースにて情報を共有しており、各機能のシームレスな連携が確立されています。
2. 容易な操作で的確な情報を提示します。

1. As for each function, information is shared by a data base, and seamless cooperation of each function can be established.
2. The accurate information can be shown by an easy operation.

高分解能磁性粉濃度測定装置

Very sensitive magnetic particle detector with high resolution.



高精度な鉄分濃度の計測

大きさが数ミクロン程度の磁性粉をも測定できるので、異常磨耗を早期に発見することができます。

High sensitivity and resolution

TF-Detector examines magnetic particles of a size down to a few micro-meters with resolution of less than 5ppm. So, you can find out abnormal wear at very early stage.

大型船用ディーゼルエンジンへの適用例

シリンダドレン油中の磨耗粉を定期的に計測することにより、ピストンの摺動状態を把握することができます。

ピストンの摺動状態に応じてシリンダ油量を調整することにより、シリンダ油の消費量を抑えることができます。

また、ピストンの摺動異常を極早期発見でき、早い段階で対処することで深刻な損傷を回避することが可能です。

Typical application to two stroke low speed engine

You can monitor piston running condition through periodical measurement of friction powder content in cylinder drain oil by TF-Detector, and then,

- You can save cylinder oil consumption by optimized feed rate setting according to piston running condition.
- You can catch a foretaste of abnormal piston running condition, and then you can take actions to avoid serious damage at very early stage.



操作が簡単

1. 試験管に少量の油を採取する。
2. 試験管を TF-Detector にセットする。
3. 計測ボタンを押すと、20 秒後以内に鉄粉濃度が表示される。

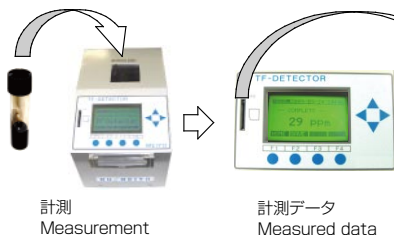
[SAVE] ボタンを押せば、日時と共に計測データを保存できます。

480 データ (24 ユニット × 20 データ) を保存可能で、SD カードに保存データをコピーすることも可能です。

Easy operation as 1-2-3

1. Sample small amount of oil in a glass tube.
2. Set a glass tube to TF-Detector.
3. Press button, then TF-Detector shows the magnetic particle density in 'ppm' within 20 seconds.

If you want, you can save the measurement data with date and time by pressing [SAVE] button. Portable TF-Detector has memory for 480 data (24 unit x 20 data), and you can copy the data to SD-card for PC.



TF-Detector

Measurement history of Portable TF-Detector
Portable TF-Detector is invented by MEIYO ELECTRIC Co., Ltd. and C.

| No. | DATE & TIME | Value (ppm) |
|-----|-----------------|-------------|
| 1 | 2015/7/27 15:08 | 25 |
| 2 | 2015/7/28 11:22 | 15 |
| 3 | 2015/7/28 14:02 | 18 |
| 4 | 2015/7/28 14:03 | 4 |
| 5 | 2015/7/28 20:15 | 6 |
| 6 | 2015/7/29 12:00 | 82 |
| 7 | No data | 0 |
| 8 | No data | 0 |
| 9 | No data | 0 |
| 10 | No data | 0 |
| 11 | No data | 0 |
| 12 | No data | 0 |
| 13 | No data | 0 |
| 14 | No data | 0 |
| 15 | No data | 0 |
| 16 | No data | 0 |
| 17 | No data | 0 |
| 18 | No data | 0 |
| 19 | No data | 0 |
| 20 | No data | 0 |

TF-Detector にデータを保存し、SD カードにコピーすることで、パソコンにて簡単に累積データとその傾向を確認することができます。

You can store the data in TF-Detector and copy to SD-card, and then you can see accumulated data and trend easily by PC.

常時遠隔監視を可能とするオンラインタイプもあります。

On-line type is also available. You can remotely monitor the magnetic particle density in the oil, continuously.

TF-Detector はディーゼルユナイテッドと明陽電機の共同開発品であり、特許出願中です。

DU and MEIYO filed an application of patent for new technologies of TF-Detector.

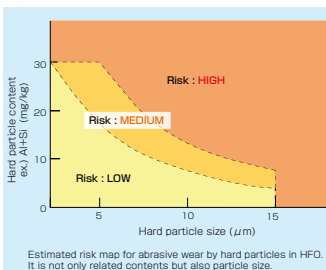
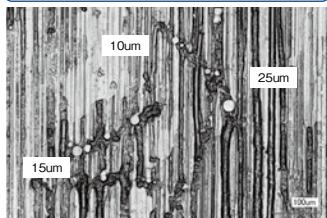


アブレシブ磨耗危険度評価キット Abrasive Wear Prevention Kit

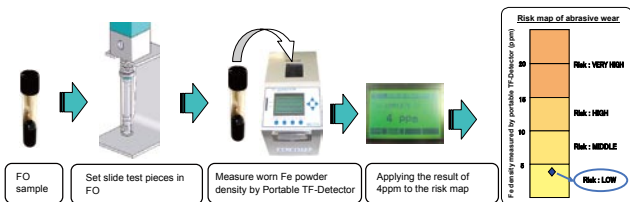
燃料油中に含まれる粒子の量、粒子のサイズ、粒子の硬さ等によってシリンダライナにアブレシブ磨耗の危険性があります。従って燃料油中の Si や Al の化学成分分析のみで、アブレシブ磨耗の危険性を完全に評価をすることは困難です。このキットは採取した燃料油中で摺動シミュレーションを行い、発生した磨耗鉄粉濃度をポータブル TF デテクターで計測することにより、アブレシブ磨耗の危険性を評価します。

The risk of abrasive wear for cylinder liner is according to amount of particles, size of particles, hardness of particles etc. in fuel oil. Therefore it is not enough to evaluate the risk of abrasive wear only by chemical component analysis of Si and Al in FO. This kit simulates sliding behavior in FO, and evaluates the risk of abrasive wear by worn Fe powder density with Portable TF-Detector.

FCC触媒粒子によるアブレシブ磨耗例
Example of sliding surface with abrasive wear by SiO_2 and Al_2O_3



新しい検査方法

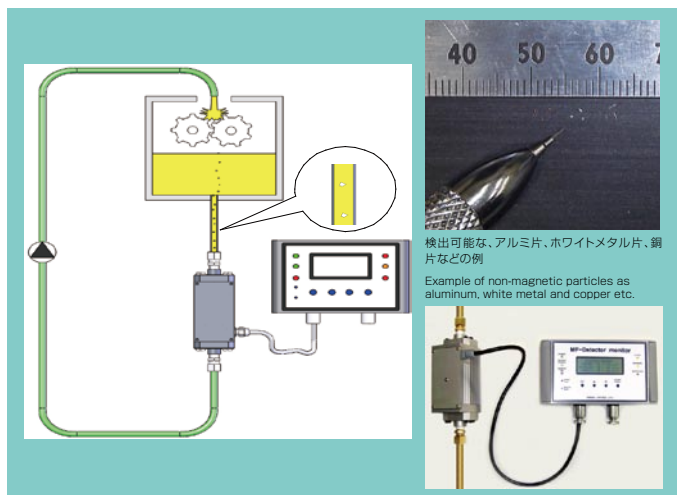


MF-Detector Metal Fragment Detector

MF ディテクター（導体片検出装置）は、LO 中の微小導体片を連続的に計測するためのセンサーです。鉄などの磁性金属だけでなく、ホワイトメタルやケルメットなどの非磁性材料の微小な片（0.4mm 程度）の発生を常時監視することが可能で、機器からの潤滑油 戻り（出口）系統に MF ディテクターを設置することにより、軸受、歯車などの損傷を早期に発見することが可能となります。

MF-Detector is the metal particle detector. MF-Detector can monitor not only magnetic particles as iron but also non-magnetic particles as white metal, aluminum, copper etc, and detectable minimum particle size is about 0.4mm. (*) So, when MF-Detector is installed on lubrication oil line, it can find damage of parts as gear, bearing etc. at early stage.

(*) Detectable size varies depending on material, shape of particle, flow speed etc.



MF-Detector モニターは、MF-Detector で検知した異物を「大」、「中」、「小」のサイズ別にカウントします。それぞれのサイズ毎に、あらかじめ設定した一定時間あたりの検知数の閾値を超えた場合は、「警告」、「警報」信号を出力することができます。

標準モニターは、記録機能がありません。記録機能付モニターは、オプションとなります。

MF-Detector monitor counts detected signal from MF-Detector by the size as small, middle and large. Set point of detected number and monitoring time can be set on the monitor, and if detected number is over than set point, monitor makes caution and alarm.



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